

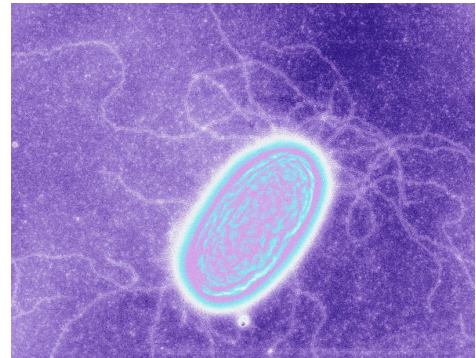
## What is electric bacteria ?

Electric bacteria (EB) is a type of bacteria which is capable of using energy in its purest form by eating and excreting electrons.<sup>[1,2,18]</sup> Nealson and his colleagues have grown electric bacteria on battery electrodes, keeping them alive with electricity and nothing else.<sup>[3]</sup> these microbes harvest electrons from rocks and metals.

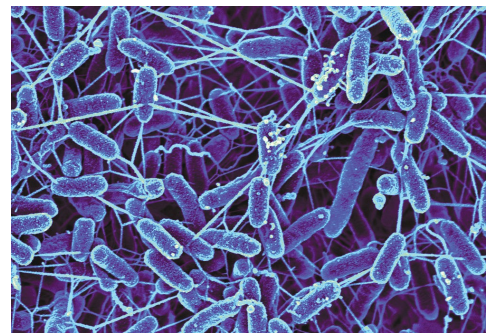
## What are the types of EB ?

Many researchers around the world have identified up to 8 different of bacteria that consume electricity. Those bacteria are different from each other.<sup>[3,7]</sup> The earliest discovered types were *Geobacter* and *Shewanella*.

***Geobacter*** is a genus of proteobacteria. *Geobacter* is an anaerobic respiration bacterial species which have capabilities that make them useful in bioremediation. it is able to transfer electrons outside the cell and transport these electrons over long distances via conductive filaments known as microbial nanowires. *Geobacter* was found to be the first organism with the ability to oxidize organic compounds and metals, including iron, radioactive metals and petroleum compounds into environmentally carbon dioxide while using iron oxide or other available metals as electron acceptor.<sup>[8,10]</sup> *Geobacter* have been found in anaerobic conditions in soils and aquatic sediment.<sup>[9]</sup>



***Shewanella*** is the sole genus included in **Shewanellaceae** family of marine bacteria. *Shewanella* bacteria is a normal component of the surface flora of fish which is implicated in fish spoilage. <sup>[11]</sup> This deep-sea bacteria grows oxygen-seeking nanowires when placed in low-oxygen environments. Researchers discovered that when the microbes nanowires are pricked with platinum electrodes, and they can carry a current. If these capabilities can be harnessed effectively.<sup>[5]</sup>



## How EB was discovered ?

The sediment from the seabed was collected. Electrodes were inserted into it. First the natural voltage across the sediment was measured, before

applying a slightly different one. A slightly higher voltage offered an excess of electrons; a slightly lower voltage meant that the electrode is willing to accept electrons from anything willing to pass them off. Bacteria in the sediments can either “eat” electrons from the higher voltage, or “breathe” electrons on to the lower-voltage electrode, generating a current. The researchers considered that picked up current as a signal of the type of life they have captured.<sup>[2]</sup>

### **What are EB applications ?**

With the help of synthetic biology, it will be possible to design biological synthetic systems to generate power, new medical applications, nanoscale biological computers, new approaches to cleaning up dangerous waste or sensitive biosensors for health or security applications.<sup>[4]</sup>

One of the applications is what UC-Santa Cruz-Biological Engineering team is working on. They reported that ‘they are designing a self-sustaining microbial fuel cell (MFC) that uses bacteria to break down organic compounds found in waste water, and generate an electric current. This is a sustainable way to generate power from waste material, with the potential of achieving over 50% energy efficiency. Santa Cruz’s project will focus on genetically engineering the bacteria *Shewanella oneidensis* in ways that will make the microbial fuel cell more efficient’. <sup>[6]</sup> Another application is to be able to produce another source of power to overcome the problem of decreased petroleum, and carbon dioxide emissions. Daniel Bond’s team from the University of Minnesota are working on isolating bacteria that can grow on the surface of electrodes and be used to release energy in the form of electricity from renewable biological sources. <sup>[13]</sup> Moreover, Lars Peter Nielsen and his colleagues at Aarhus University in Denmark have found that tens of thousands of electric bacteria can join together to form “daisy chains” that carry electrons over several centimeters which is a huge distances for a bacterium.<sup>[3]</sup>

### **What are the Pros and Cons ?**

Every thing has it’s pros and cons, with new discovered technologies comes problems that need to be solved. A good example for that is the discovery of oil which is a source for energy. It manufactured a lot of usable materials . EB is good for the environment it converts waste into fuel and doesn't depend on Fossil Fuels. In addition, EB provides a sustainable, renewable energy. However, Large areas of land are needed to create enough electricity, and all studies were in vitro. <sup>[14,15,16,17]</sup>

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### **IMAGE SOURCES :**

- *geobacter metallireducens* bacterium (Image: Derek Lovley/SPL)
- Yuri Gorby, Rensselaer Polytechnic institute